



## Case Study: Using Edge I/O to Automate Quality Control

*Intrinsics Imaging's AI-powered vision system uses groov RIO to connect the cloud to the edge*

**OPTO 22**  
Your Edge in Automation.™

## **Opto 22**

43044 Business Park Drive • Temecula • CA 92590-3614

Phone: 800-321-6786 or 951-695-3000

Pre-sales Engineering is free.

Product Support is free.

[www.opto22.com](http://www.opto22.com)

Form 2389-220308

© 2022 Opto 22. All rights reserved. Dimensions and specifications are subject to change. Brand or product names used herein are trademarks or registered trademarks of their respective companies or organizations.

## CASE STUDY: USING EDGE I/O TO AUTOMATE QUALITY CONTROL

*Intrinsics Imaging's AI-powered vision system uses groov RIO to connect the cloud to the edge*

Machine vision systems can recognize superficial aberrations in manufactured goods—like lines, spots, holes, color discrepancies, and more—that would typically require time-consuming manual inspection. However, these systems require specialized programming and maintenance, which can make them difficult to implement.

California-based [Intrinsics Imaging](#) solves this problem with its Heijunka Vision analytics-as-a-service software. Instead of programming specialized cameras, Heijunka provides a library of image processing and machine learning algorithms running in the cloud that allow any IP camera to perform intelligent defect detection.

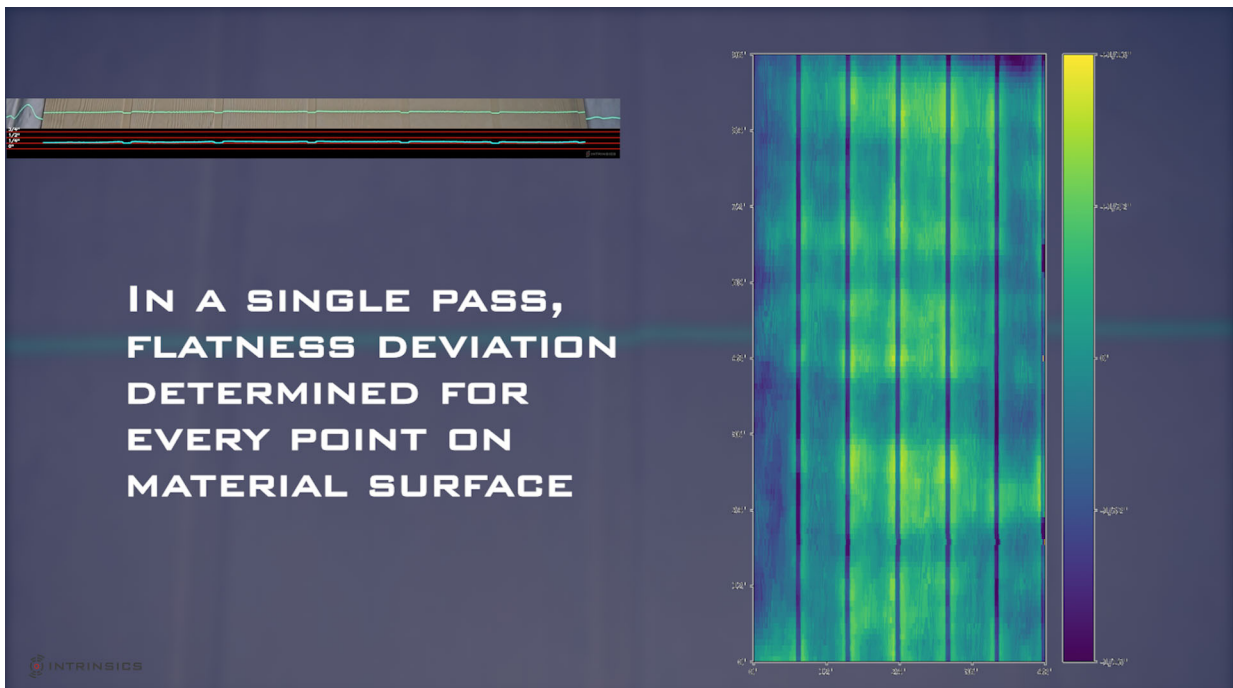
Intrinsics works with customers to tailor analytics to their specific objectives, then provides a concierge level of service so that customers no longer need to train, adapt, or maintain their vision system.



Typically, Heijunka integrates with SCADA systems to create analytics dashboards, alarms, and quality control actions. But when Intrinsics was approached by a customer hoping to integrate Heijunka directly into process controls, it looked to Opto 22's [groov RIO® edge I/O](#) for a way to connect the cloud to the edge.

### SECURING A PATH TO THE EDGE

For applications like manufacturing asphalt roofing and other kinds of building products, Heijunka not only finds



Heijunka continuously inspects in-process materials to ensure that specifications, such as dimensions, smoothness, straightness, and color, are met (source: Intrinsics Imaging).

## Case Study: Using Edge I/O to Automate Quality Control

defects in coatings, but also detects problems in fiberglass underlayment, color consistency, product wrapping, and even pallet counts. It can also continuously inspect in-process materials to ensure that specifications, such as dimensions, smoothness, straightness, and color, are met.

For this application, Heijunka would be looking at two production lines moving discrete boards at high speed.

- The primary line cuts large sheets of raw material to size. Cut sheets would need to be inspected for excess moisture as well as dents, debris, and scratches as small as a grain of rice. The customer runs hundreds of different product types through this conveyor, each being cut to a different size and configuration.
- The second line would be responsible for monitoring the quality of the milling process, specifically looking for chipping along the edges.

Unlike most Heijunka applications, the customer also wanted a PASS/FAIL I/O signal that it could integrate directly into the PLCs that would handle material rejection. By bypassing the SCADA and providing a direct path to PLC action, the customer hoped to simplify integration and reduce latency. However, Intrinsic had not integrated their cloud-based software directly with a hardware system before.

"This was surprisingly difficult to figure out," says Eric Cheng, CTO at Intrinsic. "I wasn't sure what kind of device could provide a physical interface to our cloud-based system and also satisfy our technical and operating requirements."

Besides needing a device that could tolerate an industrial environment and integrate with Heijunka's existing software stack, Eric needed something that would operate with minimal latency. From the time a given video capture was sent to Heijunka, the customer would have a roughly five-second window in which to detect and reject a problematic part. Heijunka would need to return a pass or fail indication that consistently fell within that window of opportunity.

### FINDING THE MISSING PIECE

According to Eric, Heijunka's communication infrastructure is usually built on [MQTT](#).

"Generally, we set up an MQTT broker and publish to an agreed topic," Eric explains. "It's usually new for customers,

**"Generally, we set up an MQTT broker and publish to an agreed topic. It's usually new for customers, but it's typically the best way to meet their performance and security requirements."**

**- Eric Cheng, CTO, Intrinsic**

but it's typically the best way to meet their performance and security requirements. [MQTT is] lightweight and low-latency, there's plenty of open-source support for it, and it doesn't require us to reach into their network from the outside. Amazon Web Services® (AWS) has MQTT managed services to host a broker, and in cases where we are hosting the system ourselves, it's all [deployable] out of the box and in the cloud."

In this case, Heijunka was hosted on AWS and published MQTT messages to a hosted broker, which was then bridged to an on-premises broker in the customer's facility. (Bridging allows brokers to exchange data behind the scenes so that it's available to clients on both systems.) This architecture proved to be the key factor in choosing *groov* RIO for the final piece of Intrinsic's solution.

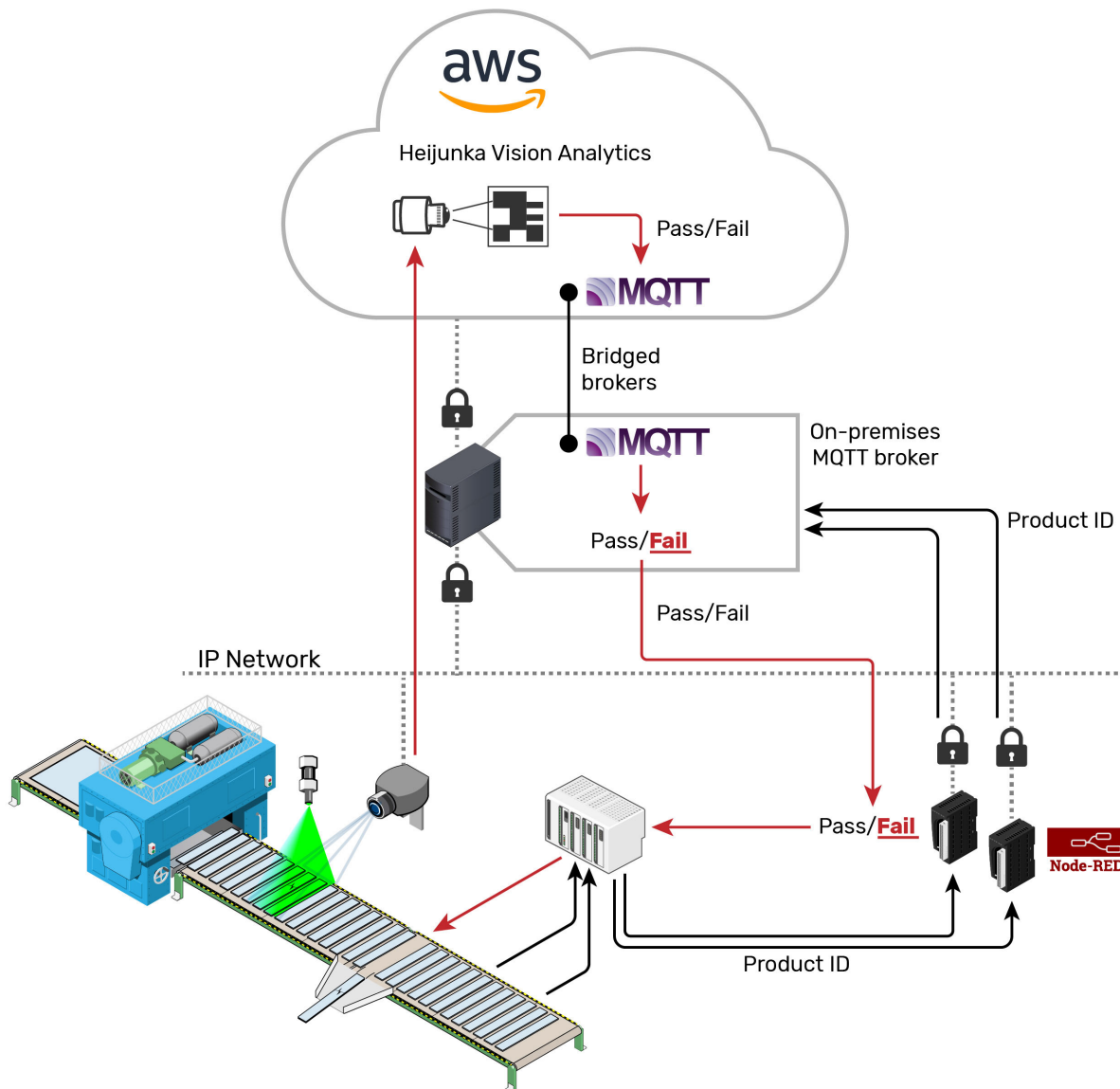
"The customer found [the Advantech ATOM], and that's what led me to *groov* RIO. I didn't want to rely on Windows 7, but Advantech made me realize that an MQTT device could work for what we were doing. *groov* RIO was exactly what we needed, and it was eye-opening to see everything we could do with it."

*groov* RIO had the industrial build Eric needed, including a wide operating temperature range and UL Hazardous Locations and ATEX approvals, as well as a Linux® core and multiple options for MQTT. Eric also appreciated that *groov* RIO provided a [web-based interface](#), a low-code [Node-RED](#) runtime, and an [embedded firewall](#) so that he wouldn't need to rely on a Windows PC for configuration, programming, and management.

Given that this was a brand-new approach for Eric, Opto 22's documentation and support were "a big deal" for him.

"[The Opto 22's sales staff] spent a lot of time holding my hand because it was all pretty new to me," he says. "I couldn't have figured it out without watching videos and talking to our sales rep. Plus the manual was great."

## Case Study: Using Edge I/O to Automate Quality Control



Intrinsics' hybrid architecture used two *groov* RIO modules on each production line to allow cloud-hosted analytics to securely control action in the physical process at the edge of the network.

## PUTTING THE CLOUD IN CONTROL

Intrinsics built an isolated network to connect cameras and *groov* RIO MM1 modules ([GRV-R7-MM1001-10](#)) to the on-premises MQTT broker. A separate network connects that broker to the internet for video streaming to Heijunka Vision and data exchange with the hosted MQTT broker, both running on AWS.

The *groov* RIO MM1 module provides 8 channels of universal I/O with support for more than a dozen software-selectable signal types. I/O data can be shared via

MQTT, REST, VPN, or traditional protocols like Modbus®/TCP and secured with user authentication, a local firewall, and TLS X.509 certificates.

In this case, each *groov* RIO module makes an encrypted connection to the local broker, which has only port 8883 open, the standard port for MQTT TLS connections. The decision to bridge between two MQTT brokers is also for security. The local broker acts as a firewall for the OT side of the system while still allowing *groov* RIO data to be exchanged with Heijunka in the cloud.

## Case Study: Using Edge I/O to Automate Quality Control

"The goal is to keep the RIOs inaccessible from the outside," says Eric.

To satisfy another customer request, each production line uses two *groov* RIO modules configured to provide eight discrete inputs each. Production line PLCs encode the product ID for the specific part being examined by Heijunka as a 16-bit integer and send each bit to one of the inputs on the RIO pair. A Node-RED flow in each RIO module publishes its eight input channels as MQTT topics, which Heijunka combines to decode the product ID and select the appropriate set of algorithms for that product type.

The *groov* RIO modules also use Node-RED to subscribe to quality indicators, which Heijunka publishes to the MQTT broker. One of the relay outputs in each pair of modules is used to indicate the PASS/FAIL decision returned by Heijunka for a given part. The production PLCs watch these outputs and use them to trigger a physical rejection of the product if needed.

Since Heijunka performs all the heavy computation and product identification, the *groov* RIO modules can run the same logic without regard for the product type, creating a clean interface between cloud and edge networks.

**"I'm impressed with how fast it is even though we are taking two or three steps. Most of that latency is due to transmitting video over the network."**

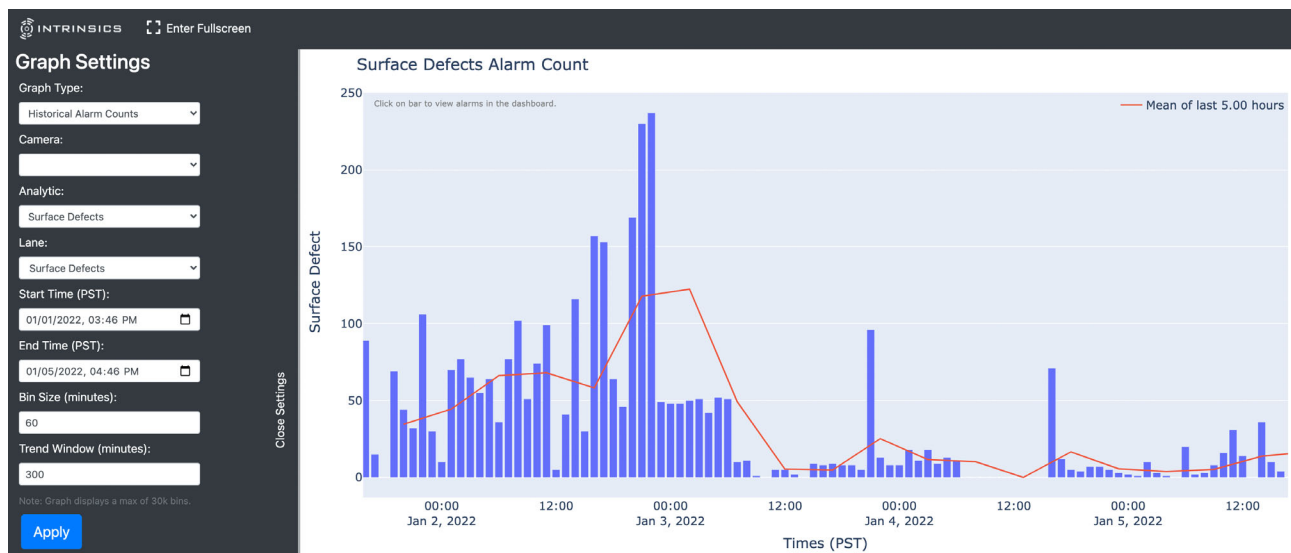
**- Eric Cheng, CTO, Intrinsic**

### FAST, AUTOMATED QUALITY CONTROL

At this point, the customer has been automatically rejecting defects for several months and plans to introduce Heijunka in the rest of its facilities. Intrinsic confirmed a round trip time, from measurement to result, of less than two seconds.

"I'm impressed with how fast it is even though we are taking two or three steps," says Eric. "Most of that latency is due to transmitting video over the network."

Intrinsic's customer is using Heijunka to save on labor costs and increase quality with an overall goal of avoiding material returns. The customer can review system performance through Heijunka's built-in trending, which displays metrics like the number of defects detected per hour. Over time, the customer can monitor historical trends



Each of the defects in the plot above indicates a product that triggered a reject signal in Heijunka that then made its way to the *groov* RIO modules via MQTT (source: Intrinsic Imaging).



## Case Study: Using Edge I/O to Automate Quality Control

in defect rates and diagnose the root cause of elevated defect levels.

A user can click on any bar in the histogram and immediately bring up replay images to see every defect the system has ever detected. Each one of the defects in the plot above indicates a product that triggered a reject signal in Heijunka, which then made its way to the *groov* RIO modules via MQTT.

"We were under the gun to do this quickly," says Eric, "but we got it figured out in less than a month... Now we can provide a direct physical interface to low-level automation systems... Using the RIOs allowed us to own more of the 'last mile' between cloud software and physical action and allowed the customer to speak the language they were most comfortable with. That allowed a cleaner separation between our software expertise and their hardware expertise."

With *groov* RIO, Heijunka can now be adapted to many more applications, supporting both hardware and software interfaces, whichever produces the best performance.

For more on Intrinsic Imaging, visit [www.intrinsicimaging.com](http://www.intrinsicimaging.com).

### ABOUT OPTO 22

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable.

Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company developed the red-white-yellow-black color-coding system for input/output (I/O) modules and the open Optomux® protocol, and pioneered Ethernet-based I/O.

Famous worldwide for its reliable industrial I/O, the company in 2018 introduced *groov* EPIC® (edge programmable industrial controller). EPIC has an open-source Linux® OS and provides connectivity to PLCs, software, and online services, plus data handling and visualization, in addition to real-time control.

*groov* RIO Ethernet-based edge I/O modules, introduced in 2020, include I/O and IIoT software in a compact industrial package that goes anywhere.

All Opto 22 products are manufactured and supported in the U.S.A. Most solid-state SSRs and I/O modules are guaranteed for life.



The company is especially trusted for its continuing policy of providing free product support, free online training, and free pre-sales engineering assistance.

For more information, visit [opto22.com](http://opto22.com) or contact **Opto 22 Pre-Sales Engineering:**

Phone: **800-321-6786** (toll-free in the U.S. and Canada) or **951-695-3000**

Email: [systemseng@opto22.com](mailto:systemseng@opto22.com)

